

UNIXTM System

Prospectus

System V

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1. EXECUTIVE SUMMARY

UNIX System V is a major release across the following processors:

- DEC+ VAX-11/780
- DEC VAX-11/750
- DEC PDP-11/70

This prospectus presents an overview of the new features provided by System V and the procedures required for transition to the new system.

The prospectus is divided into five sections.

1. Executive Summary
2. System V Overview
3. Features: A description of the new features supplied in this release.
4. Transition to System V: A synopsis of the changes that must be taken into account when moving to the new system.
5. Items no longer supported.

2. SYSTEM OVERVIEW

This section contains a listing of all the new features in System V. For a more detailed description see Section 3.

2.1 Supported Processors

System V will be issued and supported on the following processors:

VAX-11/780
VAX-11/750
PDP-11/70

The PDP system has reduced system capabilities. The features that have limited availability on the supported processors are identified in the following sections.

2.2 System V Features

The following section is a brief feature overview and list of individual features. A detailed description of the features is given in Section 3.

2.2.1 Kernel Enhancements and Changes.

2.2.1.1 Operating System Performance. The performance of the operating system on the VAX systems will be improved by a larger block file system, eliminating redundant work and providing a larger number of I/O buffers. The new features are:

- 1 Kbyte block file systems.
- Physical I/O buffer facility.
- Larger buffer pool.
- File table free list.
- Faster *fork* system call.
- Faster *open* system call (inode hashing).
- Hashing of internal sleep/wakeup mechanism (also on PDP systems).

2.2.1.2 *File System Changes*. The file system was enhanced to maintain the consistency of the disk information. This will eliminate a class of disk errors associated with system crashes. The new features are:

- Ordered writes.
- Dual *fsck* capability.
- Faster *fsck* option.
- Improved file-system access.
- *Fuser* command.
- System activity report.

2.2.1.3. *Operating System: Common Features and Enhancements*. Among the new features System V provides are an Interprocess Communication interface and *init* and *getty*. The complete list is:

- Processor type identification.
- Interprocess communication.
- *Init* and *getty*.
- New general disk driver.

2.2.2 *Enhancements and Changes for DEC Processors*. The following new devices are supported:

- Large capacity disk (516 Mbyte) drive (VAX only).
- High speed (6250 bpi) tape drive (VAX-11/780 only).
- Medium capacity (124 Mbyte) disk drive (VAX only).
- Medium speed (1600 bpi) tape drive (VAX-11/750 only).
- MOS memory.

2.2.3 *Languages and Libraries*. The language tools of System V have been changed to provide run-time efficiency and improved performance. The C library in particular has been changed to take advantage of the improvements in the operating system and to perform its functions more efficiently. The list of features includes:

- Software generation system performance improvements (VAX only).
- Improved machine language processors (VAX only).
- Library performance enhancements.
- Profiled versions of the libraries.
- Math library enhancements.
- New library functions.

2.2.4 *Communication and Networking*. The Communications and Networking Facilities of System V will provide improvements in the currently supported protocols. The list includes:

- Common Synchronous Interface.
- *Uucp* improvements.

2.2.5 *Commands and Administration Aids.* UNIX System V will provide the user and administrator with the following features:

- Incremental tape back up.
- *vi*¹ screen editor support.
- Accounting enhancements.
- Line printer spooling system.

2.3 Transition Aids

Customers will be required to perform some conversion functions when installing System V (see Sections 4 for more details). Conversion tools and instructions will be supplied for customers currently using Release System III.

The aids available are:

- *Converting to a 1K-block File System*
- *Changes to the UNIX System Archive Format*
- *User Level Changes to the C Language*
- *Common Object File Format*
- *UNIX Operating System Environment Changes: System III to System V*

The following conversion tools will be provided:

- *arcv* (1)—convert archive files from PDP-11 to common archive format
- *fsba* (1)—file system block analyzer

3. NEW FEATURES

3.1 Kernel Enhancements and Changes

Except as noted these changes are only on the VAX systems.

3.1.1 *Operating System Performance.* The performance of the operating system is improved by increasing the block size of the file system, by increasing the size of the internal system buffers, by eliminating redundant work and providing a larger buffer pool.

3.1.1.1 *1 Kbyte Block File Systems.* System V supports file systems with 1024 byte blocks and 1024 byte buffers on the VAX systems.² This provides for performance improvements I/O bound processes. While the performance increase is dependent on individual system loads, operations that do a large number of reads and writes show dramatic improvement. Performance with 512 byte block file systems will remain the same. (See also Languages and Libraries, Section 3.3.)

3.1.1.2 *Physical I/O Buffer Facility.* System V supports multiple physical I/O buffers. Once a physical I/O request is scheduled, the requesting program cannot be swapped out. Therefore, it is recommended that the *physbuf* parameter (see *config* (1M)) be set between three (on an 11/70 with \leq 1MB of memory) and five (on a VAX with \geq 2MB). Note that the faster file system checking feature, *dfsck*, described in 3.1.2.2 requires two or more physical I/O buffers.

1. The *vi* screen editor is based on software developed by The University of California, Berkeley, California Computer Science Division, Department of Electrical Engineering and Computer Science, and such software is owned and licensed by the Regents of the University of California.

2. This feature achieves the performance of the 1 Kbyte block file system of The University of California, Berkeley 4.1 BSD system while remaining compatible with the "old" 512 byte block file system.

3.1.1.3 Larger Buffer Pool. System V supports a larger number of buffers that can increase the potential for cache "hits" and thus reduce some of the disk I/O traffic. Limitations of the memory management routines previously precluded this increase. The documentation reflects these changes to the system configuration.

3.1.1.4 File Table Free List. A list of free positions in the file table reduces the overhead needed to insert a new entry into this table. The free list eliminates the linear search past all the files opened by dedicated applications initiated at boot time.

3.1.1.5 Faster Fork System Call. The previous two complete passes through the process table to complete a fork system call are reduced to one pass. This eliminates some of the overhead of every fork system call.

3.1.1.6 Fast Open System Call. Inode table hashing is implemented in System V to improve the performance of the open system call. The open system call, and all other searches of the in-core inode table, is speeded up by hashing the table and avoiding a linear search. A preliminary version of System V on the VAX showed that CPU time spent in locating an inode is reduced from 9% to 1% of the total CPU time with the addition of inode hashing.

3.1.1.7 Hashing of Sleep/Wakeup Mechanism. All processes waiting upon an event are now kept in a hash table instead of a linear list. This reduces the amount of time that the system spends looking for sleeping processes. (This feature is also in the PDP-11/70 system.)

3.1.2 File System Changes. The following file system changes are only on the VAX systems.

3.1.2.1 Ordered writes. The file system has been made more robust by controlling the order of blocks being written. This enhancement protects the file system from a serious class of errors in the event of a system crash. This scheme orders the writing of the directory and inode information, at link and unlink time, so that the link count is always positive. When a file is linked, the inode is forced to be written out to the disk so the inode information will appear before the directory information. When the file is unlinked, the directory is forced to be written out to the disk so the directory information will appear before the inode information.

3.1.2.2 Dual fsck capability. Dfsck is a new utility that speeds up file system checking on multi-drive machines by executing two fscks in parallel. To do this, the dfsck procedure uses the multiple physical I/O buffer feature mentioned in 3.1.1.1. Careful use of this utility can save over 40% on file system checking time.

Due to the file system load balancing required for dual checking, the dfsck command should always be executed through the checkall (1M) shell procedure.

3.1.2.3 Faster Fsck Option. Since the file system will be more resistant to corruption (see Ordered Writes above), there is an addition to fsck to allow for quick recovery from crashes. The addition of a "fast" option (-f) to fsck will skip phases 2, 3 and 4 (see fsck (1M)), which are often the most time-consuming and I/O-intensive phases. It will check the i-list, check and rebuild the free list if necessary, and, then, ensure that there is no damage that could further corrupt the file system. A full fsck is still needed at file-save time to assure consistency of the file system.

3.1.2.4 Improved File-System Access. System V provides a new file-system reorganization utility, dcopy, which reorders files and directories to optimize file-system access. On an otherwise idle system, a reorganized file system has almost twice the I/O throughput of a randomly organized file system. This applies, for example, to file copying, finds, and fscks. Note that during reorganization, the file system must be unmounted. See dcopy (1M) for details.

3.1.2.5 Fuser. The fuser (1M) command allows administrators to identify and kill processes associated with a particular file system, terminal line, or any other file. See fuser (1M) for details.

3.1.2.6 System Activity Report (SAR). New performance measurement counters have been added in the operating system for use by the sar (1) commands.

3.1.3 Operating System: Common Features and Enhancements.

3.1.3.1 Processor Type Identification. The uname command will now print the machine type and subtype, for example, pdp-11, or vax-780.

3.1.3.2 Interprocess Communication. Interprocess communication routines are now available on the DEC VAX-11/780, and VAX-11/750, and a modified routine package is available for the PDP-11/70. These routines include shared memory, messages, semaphores, and process locking. Also included is an IPC-remove command, *ipcrm* (1) which removes message, semaphore, and shared-memory identifiers from the system.

3.1.3.3 Init and Getty. System V provides the new interface programs *init* and *getty*. These changes affect the operator interface, the system administrator interface and the user interface. (See Section 4.)

3.1.3.4 New General Disk Driver. The new general disk driver will support four different standard disks (RP06, RP07, RM05 and RM80) on a single controller, and it will also support up to four controllers.

3.2 Enhancements and Changes for DEC processors.

3.2.1 KMC/DZ Asynchronous Line Support. The KMC/DZ asynchronous line interface has been changed for the new line disciplines. KMC11-A support has been dropped from this release.

3.2.2 KMC-11 Used More Effectively. Measurements have uncovered a potentially serious performance problem affecting the KMC-11 front-end processor and the DZ-11 line unit. The KMC-11 produced excessive processor load by passing characters to the CPU one at a time. System V software fixes this problem and reduces the host load to reasonable values by ensuring that characters are transferred to the CPU in batches whenever possible. This fix will reduce the processor load on input data from a high of 20 to 40 percent to negligible.

3.2.3 PDP-11/70.

3.2.3.1 Expanded Kernel Space. System V implements a scheme to provide expanded kernel text space by utilizing the PDP-11/70 memory-management hardware. This enhancement will provide space for the introduction of new drivers.

3.2.3.2 Memory Recommendations. The recommended minimum amount of memory for running the UNIX System on a PDP-11/70 is 3/4 megabyte, although the suggested amount is 1 megabyte.

3.2.3.3 Smaller In-Core Inode Table. An inode table cache has been added for the PDP-11/70 so that system data space may be saved.

3.2.4 VAX.

3.2.4.1 Updated Features. System V includes the following updated features for the VAX:

- Power-fail recovery is improved and fully supported.
- New *iltld* and floppy-disk procedures allow booting from RP04/5/6 and RM05 disks.
- A new dump facility writes 5120-byte blocked tapes recorded at 1600 BPI.

3.2.4.2 Memory Recommendations. The recommended minimum amount of memory for running the UNIX System on a VAX is 1 megabyte, although the suggested amount is 2 megabytes.

3.2.4.3 Disk Formatting Utility. System V provides one command, *format* (1M), to format both the RP06 and RM05 disk packs.

3.2.4.4 Vcf Utility. *Vcf* is a stand-alone utility that tests for the presence of both MASSBUS and UNIBUS³ devices. The resulting list of addresses is compared with the operating system object module (/unix). Any device address and interrupt vector discrepancies are reported. A complete configuration list can also be generated. See *vcf* (1M) for details.

This utility should be run after any DEC service or any operating-system software change.

3.2.5 Support for New DEC Peripherals.

3.2.5.1 RP07 Disk Drive (VAX Only). The RP07 is a large-capacity, non-removable, high-performance disk drive, built with "Winchester-type" technology. It has a capacity of 705 Mbytes unformatted, 516 Mbytes

3. MASSBUS and UNIBUS are trademarks of Digital Equipment Corporation.

formatted. The average transfer rate is 1.5 Mbytes per second with non-interleaved sectors or 0.75 Mbytes per second with interleaved sectors. The drive is supported as part of the general disk driver (*gd(7)*) on the VAX line only. Two interleaved memory controllers will be required for non-interleaved sector operation.

3.2.5.2 RM80 Disk Drive (VAX Only). The RM80 is a medium-capacity, non-removable, high-performance disk drive. It has a formatted capacity of 124 Mbytes and an average transfer rate of 0.9 Mbytes per second. The drive is supported as part of the general disk driver (*gd(7)*) on the VAX line only.

3.2.5.3 TU78 Tape Drive (VAX-11/780 Only). The TU78 is a 9-track tape drive capable of recording data in phase-encoded format at 1600 bpi or in group-code recording format at 6250 bpi. The tape speed is 125 ips. The drive and controller can be configured with the TU16/TM03 tape drive on the same adapter (see *gt(7)*). The drive is supported by a new combination TU16/TU78 tape driver on the VAX line only. The drive can serve as a boot device.

3.2.5.4 TU77 Tape Drive (VAX Only). The TU77 is a 9-track tape drive capable of recording data at 800 bpi or 1600 bpi at a tape speed of 125 ips. The drive can serve as a boot device for both the 11/780 and 11/750 systems.

3.2.5.5 TS-11 Tape Drive (VAX-11/750 Only). It is a 9-track tape drive that records only in phase-encoded format at 1600 bpi and 45 ips. It is only supported on the VAX-11/750 and may serve as a boot device.

3.2.5.6 ML-11 MOS Memory System. The ML-11 is a fast MOS-memory system that operates in block-mode and emulates an RP06 disk drive. It has a capacity of 1 to 4 Mbytes and a transfer rate of 0.25 to 2.00 Mbytes per second. It is supported as part of the general disk driver (*gd(7)*). The device is not usable as either a boot device or an initial load device. Intended for the PDP-11/70, it should yield faster "swap" and "tmp" operations.

3.3 Languages and Libraries.

3.3.1 C Programming Language. System V includes the following changes to the C programming environment:

- System header files have been reorganized to be mutually exclusive, and some have been enhanced. Therefore, it is advisable to recompile all C programs.
- A new cross-reference program—*cxref(1)*—is designed to replace both *cref(1)* and *xref(1)*.
- A new flow-analysis program—*cflow(1)*—will analyze a group of C, YACC, LEX, assembler, and object files and will construct a graph of the external references.
- Change mode (*chmod*) and change owner (*chown*) commands will now fail properly on open files on read-only file systems.

3.3.2 Portable C Compiler. System V changes the machine independent parts of the Portable C Compiler. The major changes deal with obsolete initialization and unsupported operators. For more details, refer to the transition information in Section 4.

3.3.3 C Pre-processor (*cpp*). The C pre-processor now has a separate manual page (*cpp(1)*) but may only be invoked from the *cc* command. *Cpp* now conforms to the C language specification in the handling of white space and should not be used for general macro processing. (The macro processor *m4* is recommended for general use.)

3.3.4 Cc Command. The *cc* command gives the user greater control over the compilation process with the ability to pass options explicitly to the subprocesses.

3.3.5 Software Generation System (SGS) Performance (VAX only). An SGS is a set of programming tools that support software development for a processor running a UNIX System. It consists of a C language compiler, optimizer, link editor plus a set of utilities that perform object file listing and analysis functions. The compile-time speed of the VAX SGS is improved by making the assembly and link-edit stages more efficient. The link-edit stage is particularly improved by the use of random access archive files (libraries), thus eliminating the lengthy linear searches. The archive redesign also eliminates most of the cases where it was necessary to use *lorder(1)* to order the libraries.

3.3.6 Machine Language Processor (MLP) (VAX only). A new machine language processor using the Common

Object File Format is implemented for the VAX processor. The new MLP has not been implemented on the PDP-11/70 due to address space limitations.

The new VAX object file format is not compatible with the previous object file format (see Transition Problems in Section 4).

3.3.7 Library Performance Enhancements. Many C library routines include performance enhancements, the most notable being improvements in the I/O functions. Some of the changes provided by System V are listed below:

- The buffers of the System V standard I/O library are increased to improve performance.
- The *stdio*(3S) family of string-output functions have been modified to invoke buffering on a per-line basis (to terminals) if full buffering has not been specified. Characters will be collected and then flushed with one *write*(2) system call per string, instead of one call per character, even if non-buffering has been specified.
- Both *putchar*(3S) and *getchar*(3S) now return unsigned character data.
- New 48-bit random number routines for the VAX and the PDP-11/70 have been added. See *drand48*(3C) for details.
- For the *fopen*(3S) routine, the append mode is now enforced strictly. This means that when the 'a' or 'a+' mode is specified, all writes to the FILE will be dynamically forced to the current end-of-file regardless of preceding seeks.
- The *printf*(3S) family of functions has been replaced on the PDP-11/70 with an assembly-language version that is significantly smaller and faster. In addition, *printf* now works correctly in an interrupt routine, even if *printf* was the entity interrupted.
- The *malloc*(3C) routine no longer returns pointers to overlapping regions.
- The *getpwent*(3C) routine now checks for USER IDs greater than MAXUID (as defined in */usr/include/sys/param.h*) in */etc/passwd*.
- In the external variable *environ*, either the NULL pointer or a pointer to a null string is now an acceptable indication of a null environment.

3.3.8 Profiled Versions of the Libraries. Separate versions of the C library and Math library are available to support user-level profiling. The separate versions allow users to receive profiling information on library functions at the same time they receive profiling information about their own code. These libraries are loaded automatically by *cc -p* on the VAX systems. PDP-11/70 users must specify the files */lib/libp/libc.a* and */lib/libp/libm.a* explicitly to obtain the profiling information.

3.3.9 Math Library Enhancements. Additions to the math library functions make it easier for users to detect and recover from errors. The library functions distinguish between different types of errors and produce fatal error messages in a few cases. The previous implementations of math library would either core dump or ignore errors. The core dumping problem is replaced with default error messages. In the case of these and other errors the users may choose to supply their own error handling routines and exit or recover with or without error messages.

3.3.10 Expanded Fortran Programming Support Tools. Two new Fortran utility programs have been added: *asa*(1) and *fsplit*(1). *Asa* is used to interpret ASA carriage-control characters, and *fsplit* is used to split F77, RATFOR, or EFL files into separate files.

3.3.11 Fortran 77. Fortran 77 and related commands (*asa*, *fsplit*, *efl*, *ratfor*) are available for the first time on the VAX and PDP-11/70 for System V. Continuing development on the Fortran 77 compiler has improved both the compile-time and the run-time speeds over the version released in System III. However, many of the improvements are only in the VAX implementations. The PDP-11/70 implementation is limited by insufficient address space.

3.3.12 Library Functions. New library functions in the System V release are *dial* (3C), *erf* (3M), *frok* (see *stdipc*(3C)), *ftw* (3C), *tempnam* (see *tmpnam* (3S)), *clock* (3C) and five functions to manipulate memory (see *memory* (3C)).

The *assert* (3X) function is changed to invoke *abort* (3C) rather than *exit* (2) when an assertion fails. This provides the user with an automatic "core dump" from which to debug a failure that may be difficult to reproduce.

3.3.13 Other Tools. The *yacc* (1) parser generator has improved optional debugging and produces a faster parser. The symbolic debugger *sdb* (1) is improved. (*Sdb* (1) is not available on the PDP-11/70.) These improvements make the *adb* (1) command on the VAX system obsolescent. The profiling command *prof* (1) has also been improved and the options and output are now the same for all processors.

3.4 Communication and Networking.

3.4.1 Common Synchronous Interface (CSI). CSI provides a standard interface between Level 3 protocols executing as host drivers and Level 2 protocols executing in Programmable Communications Devices (PCDs). CSI makes protocol drivers such as VPM (see below) and the new Level 3 protocol drivers portable across the line of supported processors. The alternative requires writing and supporting individual protocol drivers for each PCD and processor.

3.4.2 Line Disciplines and Virtual Terminal Interface. System V allows substitution of user-written terminal-handling routines for the default system provided routines. This also makes possible the use of a virtual terminal language as one of the sub-line disciplines.

3.4.3 VPM: Virtual Protocol Machine.

3.4.3.1. KMS11 Support. This release of the Virtual Protocol Machine has been enhanced to support not only the KMC11-B microprocessor, but also the KMS11, a DEC microcomputer capable of multiplexing eight synchronous communication links. However, the VPM for the KMS11 does not support BISYNC protocol.

3.4.3.2 Time Stamp on Trace. Time stamping in the trace driver is added to allow better debugging of VPM scripts. (The "stamp of time" on an error during execution is valuable information when trying to position the error within the dynamic program flow.)

3.4.3.3 Power-fail/Restart. The power-fail/restart feature is extended to cover the VPM interface driver. This provides power-fail/restart for all protocols that use VPM (e.g., RJE).

3.4.3.4 The Vpmtest Command. A new command, *vpmtest*, is provided to perform a series of loop-back tests on a user-specified synchronous line. Another new command, *vpmsfr*, executed by *vpmtest* transmits and receives a known data stream and compares the received data stream with the one expected.

3.4.4 Networking.

3.4.5 Uucp. The following enhancements are supplied:

- A silent option for *uux*(1) is included to suppress mail.
- An improved dialing algorithm is included to increase the number of successful connections.
- A job ID is returned by *uucp*. This job ID allows job status and job deletion to be done.
- Forced routing similar to that simulated by *mail*(1) (e.g., *uucp x a!b!x*) is provided.
- A number of bugs involving execution under the correct user ID have been fixed.

3.5 Commands and Administration Aids.

3.5.1 Tape Back Up. Three new commands are supplied to do faster back-ups and incremental saves.

The command *ff*(1M) performs many of the functions of *find*(1) in generating the path for selected files in a *find* (1) for this application.

The command *finc*(1M) copies selected files to tape in a format much like *volcopy*. Selection criteria (such as "newer than specified file", "untouched in xx days", etc.) reminiscent of *find*(1) can be used. Typically *find*(1M) is faster than the equivalent *find/cpio* commands for large amounts of data. *Finc*(1) tapes are limited to a single tape reel. If an *finc* incremental exceeds one reel, a *volcopy*(1M) backup is recommended.

The command *frec*(1M) performs recovery of files from *volcopy*(1M) or *finc*(1M) tapes. Files to be recovered are requested using their inode numbers. This information is available from the *ff*(1M) output that should be preserved when running any *finc*(1M) or *volcopy*(1M).

Also, the *volcopy*(1M) command has a new option, *-buf*, for double buffering I/O. This option provides significant performance improvement.

3.5.2 Screen Editors. The *vi* editor for use with asynchronous CRT terminals is supported.

Vi(1) is a display oriented interactive editor developed at the University of California, Berkeley. It will work on a large number of terminals described in a terminal description file (*termcap*(5)) that is included with the release. The terminal descriptions included in this file are not guaranteed to be correct; some have been used more than others and none has been exhaustively tested. Descriptions of new terminals may easily be added to the *termcap*(5) file simply by editing it. A user adding a new terminal description to the file will also have the responsibility for insuring the accuracy of the entry and testing it out on the terminal. *Vi*(1) has been in use in the field as part of the University of California's 4.1 BSD system (as well as previous releases) and has proven to be an effective tool for both program development and document preparation.

The *termcap*(5) terminal description file is supported.

3.5.3 Accounting. Two new options (i.e., *S* and *E*) are added to *acctcom* to facilitate the new options added to *timex*.

3.5.3.1 Rewritten Timex. The *timex* command is rewritten in a machine-independent way and formatted in the style of the *sar* output. New options for reporting user processes, resource usage and overall system activity are added.

3.5.3.2 Sdtp. The *sdtp* command reports disk access located and seek distance in either tabular or histogram form.

3.5.4 Line Printer Spooling System. LP is a system of commands that perform diverse spooling functions under the UNIX operating system. Its primary application is off-line printing. LP allows administrators to customize the system to spool to a collection of line printers of any type and to group printers into logical classes in order to maximize the throughput of the devices. Users are provided the following capabilities:

- queuing and canceling print requests,
- allowing or preventing queuing to devices and printing on devices,
- starting and stopping LP from processing requests,
- changing the configuration of printers, and
- finding the status of the LP system.

4. Transition to System V.

System V is an initial load system. The release tapes must be installed as delivered and cannot be used to update an existing system.

4.1 File System Conversion (VAX)

4.1.1 Initial Boot. The System V will be delivered with 1 Kbyte block *root(/)* and *user(/usr)* file systems. After the new system is read in and booted, the system administrator may copy local files from the site backups. Any of the standard UNIX system tools may be used to transfer the old files to the new file system. Care should be taken not to overwrite the file system check *fsck*(1) or any of the accounting programs. In general it is wise not to overwrite any of the files delivered with the new system (except those intended for local modification).

4.1.2 Conversion of Existing File Systems. Any of the existing file systems may be converted to the larger block size. Since existing file systems are compatible with the System V, no special conversion tools are necessary. Files resident under an old file system may be copied to a new (1 Kbyte block) file system using *cpio(1)* and *find(1)* or the *finv(1)* and *frec(1)* routines.

4.1.2.1 Cautions. Because of the possibility of additional wasted space on 1 Kbyte block file systems, conversion of full and nearly full 512 byte block file systems may not be possible using the same disk space. A transition tool (file system block analyzer *fsba(1)*) is supplied to summarize the space usage on a small block file system the project the usage on a large block file system.

Also, because *cpio(1)* has a limit to the number of unique linked files it can remember, care must be taken when converting a file system with a large number of these files.

4.1.3 Re-Compilation of Users' Software. Under code and application code that uses the standard I/O library should be recompiled to take advantage of the larger buffer size of the new library. The recompiled code is fully compatible with both file systems and will be more efficient even when using 512 byte file systems.

4.1.4 Modification of Users' Software. User and application code not using standard I/O or doing its own buffering may need to be changed to take advantage of the new file system. Internal buffers used for I/O should be set to be a multiple of 1024 bytes so that they will efficiently match the internal buffer size of the System V. The buffer size may be specified (in a portable way) by using the define constant *BUFSIZ* from the header file *stdio.h*.

User code and application code that access the file system devices directly must be examined (and probably changed) and recompiled so that they are in accord with the new file system structure.

4.2 Init & Getty Interface

4.2.1 Init. The entries in the */etc/inittab* (see *inittab(5)*) file have been changed as part of the new interface, so that it is not possible to use the old */etc/inittab* file. More states are now possible for spawning programs, and users should read the manual page carefully to select the proper action when a process terminates. Changing from multi-user state to single-user state is done by using *init* as a command, however; the single-user state is now called *s* (instead of *1*) so that the command

```
init s
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brings the system into single user mode. A command file */etc/brc* (see *brc(1M)*) is now executed when the system is booted so commands to download devices should be placed here. A similar file */etc/powerfail* (see *brc(1M)*) is available for power fail recovery.

4.2.2 Getty. The line speed table is now in the file */etc/gettydefs*, so that the sequence of line speeds can be edited on line. (No recompilation of the *getty(1M)* command is necessary.)

The options to *getty* are slightly different and are documented in the manual pages.

4.2.3 Related Changes. Because of the changes to *init*, the format of the */etc/utmp* and */etc/wtmp* files are not compatible with previous systems. Users who have written private copies of commands that use these files should be prepared to adopt the new format. Library routines (*getut(3c)*) are provided to ease the conversion.

4.3 Object File Conversion (VAX)

4.3.1 Old Executable Files. Old (pre-System V) executable object files will continue to execute under System V. Only those programs whose functionality is impacted by other changes (see the rest of this section) need to be recompiled.

4.3.2 Old Object Modules. Old (pre-System V) object modules (non-executable object files) are not compatible with the object modules produced by the System V assembler (*as(1)*) or linkage editor (*ld(1)*). They should be replaced by versions recompiled with the System V Software Generation System (SGS).

4.3.3 Old Archive Files. Old (pre-System V) archive files are not compatible with archive files of the System V release. They should be replaced by archives created with the system V *ar(1)* command or converted with the *arv(1)* command.

4.3.4 *Old Libraries*. Libraries are archive files; see 4.3.3. above.

4.4 C Source Files

4.4.1 *Modification of existing code*. The use of old-style initialization (e.g. $\text{long} \times 1$) and old-style assignment operators (e.g. $=+$, $=-$) will no longer be allowed. All existing code that uses these constructs must be upgraded. The current compilers and *lint* (1) complain explicitly about these constructs.

The use of integer constants with compilers that generate code for 16-bit machines should be reviewed. The compiler now conforms to the language specification for octal and hex constants. The previous implementation erroneously converted octal and hex constants which exceeded the largest signed machine integer to long constants. These constants should only be extended if they exceed the largest unsigned machine constant. Octal and hex constants with the high order (16th) bit on will now have the exact 16 bit pattern and may act like signed negative numbers in expressions.

5. ITEMS NO LONGER SUPPORTED

5.1 DQS on the PDP-11/70

Software using the DQS-11 (BISYNC Synchronous Line Interface) was released for the last time in System III. This means that the UNIVAC and IBM RJE (DQS-based) software will not be included in System V. RJE will be fully supported on the DEC line (KMC-based).

5.2 *fget.demon* and *fget.odemon*

The *fget.demon.lc* and *fget.odemon.lc* commands will no longer be documented in the User's Manual and should not be used except through invocation by *fget*.

5.3 KMC11-A.

A KMC11-A will no longer be supported.